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Proposed Re-evaluation Decision PRVD2010-12

Thiabendazole

(publié aussi en français)

21 July 2010

This document is published by the Health Canada Pest Management Regulatory Agency. For further information, please contact:

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Canada

HC Pub: 100295

ISBN: 978-1-100-16049-8 978-1-100-16050-4
Catalogue number: H113-27/2010-12E H113-27/2010-12E-PDF

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Overview

What Is the Proposed Re-evaluation Decision?

After a re-evaluation of the pesticides containing thiabendazole, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration of products containing thiabendazole for sale and use in Canada.

An evaluation of available scientific information found that products containing thiabendazole do not present unacceptable risks to human health or the environment when used according to label directions. As a condition of the continued registration of thiabendazole uses, new risk-reduction measures are proposed for the labels of all products.

It should be noted that for end-use products containing more than one active ingredient (a.i.) under re-evaluation, registration status might change as a result of the re-evaluation of the remaining affected active ingredients.

This proposal affects all end-use products containing thiabendazole registered in Canada. Once the final re-evaluation decision is made, the registrants will be instructed on how to address any new requirements.

This Proposed Re-evaluation Decision (PRVD) is a consultation document[1] that summarizes the science evaluation for thiabendazole and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of thiabendazole.

The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (please see contact information indicated on the cover page of this document).

[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

What Does Health Canada Consider When Making a Re-evaluation Decision?

The PMRA's pesticide re-evaluation program considers potential risks, as well as value, of pesticide products to ensure they meet modern standards established to protect human health *and* the environment. Regulatory Directive DIR2001-03, *PMRA Re-evaluation Program*, presents the details of the re-evaluation activities and program structure.

Thiabendazole, one of the active ingredients in the current re-evaluation cycle, has been re-evaluated under Re-evaluation Program 1. This program relies as much as possible on foreign reviews, typically United States Environmental Protection Agency (USEPA) Reregistration Eligibility Decision (RED) documents. For products to be re-evaluated under Program 1, the foreign review must meet the following conditions:

- it covers the main science areas, such as human health and the environment, that are necessary for Canadian re-evaluation decisions;
- it addresses the active ingredient and the main formulation types registered in Canada; and
- it is relevant to registered Canadian uses.

Given the outcome of foreign reviews and a review of the chemistry of Canadian products, the PMRA will propose a re-evaluation decision and appropriate risk-reduction measures for Canadian uses of an active ingredient. In this decision, the PMRA takes into account the Canadian use pattern and issues (e.g. the federal Toxic Substances Management Policy [TSMP]).

Based on the health and environmental risk assessments published in the 2002 RED, the USEPA concluded that thiabendazole was eligible for reregistration provided risk-reduction measures were adopted. The PMRA compared the American and Canadian use patterns and found the USEPA assessments described in this RED were an adequate basis for the proposed Canadian re-evaluation decision. When necessary, additional risk assessments were conducted by the PMRA.

For more details on the information presented in this overview, please refer to the Science Evaluation section of this consultation document.

What Is Thiabendazole?

Thiabendazole is a fungicide that is used to control fungal diseases on fruits and vegetables. Thiabendazole is applied as postharvest spray treatment on apples, pears, potatoes and chicory roots (intended for Belgian endive production), a drench on white button mushrooms, and as a pre-planting treatment of chickpea and lentil seed. Thiabendazole is also registered for use in control of Dutch elm disease in elm trees and as a material preservative in paints, adhesives, paper and textiles.

Health Considerations

Can Approved Uses of Thiabendazole Affect Human Health?

Thiabendazole is unlikely to affect your health when used according to the revised label directions.

People could be exposed to thiabendazole by consuming food and water, working as a mixer/loader/applicator, by entering treated sites or by handling thiabendazole-treated products. The PMRA considers two key factors when assessing health risks: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (for example, children and nursing mothers). Only uses for which exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration.

The USEPA concluded that thiabendazole was unlikely to affect human health provided that risk-reduction measures were implemented. These conclusions apply to the Canadian situation, and similar risk-reduction measures are proposed. Additional mitigation measures are recommended based on risk assessments conducted by the PMRA.

Maximum Residue Limits

The *Food and Drugs Act* prohibits the sale of food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for *Food and Drugs Act* purposes through the evaluation of scientific data under the *Pest Control Products Act*. Each MRL value defines the maximum concentration in parts per million (ppm) of a pesticide allowed in/on certain foods. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Thiabendazole is currently registered in Canada for use on apples, pears, potato, and chicory root, white button mushrooms and on chickpea and lentil seed, and could be used in other countries on crops that are imported into Canada. The following specific MRLs have been established: apple (wet pomace) 10 ppm, pear 10 ppm, potato 10 ppm, citrus fruit 10 ppm, banana 0.4 ppm and endive (chicory roots) 0.05 ppm. Where no specific MRL has been established, a default MRL of 0.1 ppm applies, which means that pesticide residues in a food commodity must not exceed 0.1 ppm. However, changes to this general MRL may be implemented in the future, as indicated in the December 2009 Information Note, *Progress on Minimizing Reliance on the 0.1 Parts per Million as a General Maximum Residue Limit for Food Pesticide Residue.*

Environmental Considerations

What Happens When Thiabendazole Is Introduced Into the Environment?

Thiabendazole is unlikely to affect non-target organisms when used according to the revised label directions.

Environmental risk is assessed by the risk quotient method—the ratio of the estimated environmental concentration to the relevant effects endpoint of concern. The resulting risk quotients are compared to corresponding levels of concern. A risk quotient less than the level of concern is considered a negligible risk to non-target organisms, whereas a risk quotient greater than the level of concern indicates some degree of risk.

The USEPA concluded that thiabendazole was unlikely to adversely affect the environment and, the reregistration of thiabendazole was acceptable. No mitigation measures were required by the USEPA. These conclusions apply to the Canadian situation. Based on PMRA practices, general environmental hazard label statements are proposed by the PMRA.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law. As a result of the re-evaluation of thiabendazole, the PMRA is proposing further risk-reduction measures for product labels.

Human Health

- Additional PPE for workers involved in the post-harvest treatment of food commodities and, for on-farm and commercial seed treatment activities, and tree treatment.
- A 12-hour restricted-entry interval (REI) for all agriculture uses.
- A limit of potato tubers treated per day to 500,000 kg per worker.
- Restriction of post-harvest application methods to mechanical sprayer application only.
- Restriction of seed treatment methods to commercial and on-farm treaters using auger treatments only.
- Packaging of powder end-use formulation in water soluble pouches.
- Rate reduction to 0.2% thiabendazole in paint.
- Limitation of thiabendazole-treated materials to non-food use only.

Environment

- General environmental hazard label statements for aquatic species and effluent discharge.

Next Steps

Before making a final re-evaluation decision on thiabendazole, the PMRA will consider all comments received from the public in response to this consultation document. The PMRA will then publish a Re-evaluation Decision[2] document that will include the decision, the reasons for it, and a summary of comments received on the proposed decision and the PMRA's response to these comments.

[2] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Science Evaluation

1.0 Introduction

Thiabendazole is a fungicide that is used to control fungal diseases on fruits and vegetables, as well as in control of Dutch elm disease in elm trees. It is also used as a material preservative. The mode of action includes inhibition of transamination and interference with the transfer of amino acids in protein synthesis.

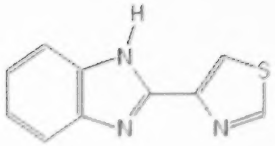
Following the re-evaluation announcement for thiabendazole, the registrant of the technical grade active ingredient in Canada indicated their intention to provide continued support for all uses included on the labels of commercial end-use products in Canada.

The PMRA re-evaluation is mostly based on recent assessments of thiabendazole from the United States Environmental Protection Agency (USEPA). When necessary, additional risk assessments were conducted by the PMRA. The USEPA Reregistration Eligibility Decision (RED) document for thiabendazole, dated 2002, and Tolerance Action published in 2007 in the Federal Register, as well as other information on the regulatory status of thiabendazole in the United States can be found on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

2.0 The Technical Grade Active Ingredient, Its Properties and Uses

2.1 Identity of the Technical Grade Active Ingredient

Common name	Thiabendazole
Function	Fungicide
Chemical Family	Benzimidazole
Chemical name	
1 **International Union of Pure and Applied Chemistry (IUPAC)**	2-(1,3-thiazol-4-yl)benzimidazole
2 **Chemistry Abstracts Service (CAS)**	2-(4-thiazolyl)-1H-benzimidazole
CAS Registry Number	148-79-8
Molecular Formula	$C_{10}H_7N3_S$

Structural Formula	
Molecular Weight	201.25 amu
Purity of the Technical Grade Active Ingredient	99.2 NS (limits: 98.5–100%)
Registration Number	19065

Based on the manufacturing process used, contaminants of human health or environmental concern as identified in the Canada Gazette, Part II, Vol. 142, No. 13, SI/2008-67 (2008-06-25), including TSMP Track 1 substances, are not expected to be present in the product.

2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Table 1 Physical and Chemical Properties of Thiabendazole

Property	Result	Interpretation
Vapour pressure	4×10^{-9} mmHg (4.6×10^{-4} mPa)	Low volatility
Henry's law constant	2.7×10^{-8} Pa•m^3•mol^{-1}	Non-volatile from a water surface or moist soil
UV/Visible spectrum	Not expected to absorb UV at $\lambda > 300$ nm	Phototransformation is unlikely
Solubility in water	pH g/L 4 0.16 (160 ppm) 7 0.03 (30 ppm) 10 0.03 (30 ppm)	Very soluble in water. Concern for leaching. Soluble in water Soluble in water
***n*-Octanol/Water partition coefficient**	pH $LogK_{ow}$ 4 1.39 7 2.12 10 2.12	Bioaccumulation is unlikely
Dissociation constant	$pK_{a1} = 4.73$ $pK_{a2} = 12$	Mobile at normal pH. Mobility increases with increase in pH

2.3 Comparison of Use Patterns in Canada and the United States

In Canada, thiabendazole is registered for use as:

- post harvest-treatment of apples and pears as a spray, dip or flood with an application rate of 0.5 g a.i./L; on potatoes as a spray with an application rate of 44 g a.i./1000 kg; and on chicory root as a spray with an application rate of 40 g a.i./1,000 kg;
- a drench on white button mushrooms at an application rate of 127.5 g a.i./100m^2;
- a pre-plant treatment of chickpea and lentil seed at an application rate of 34.8 g a.i./100 kg seed;
- an elm tree treatment at a maximum application rate of 5.5 g a.i./L;

- a material preservative in paints, adhesives, paper and textiles at a maximum application rate of 0.33% a.i. in the final product.

The end-use products are formulated as a solution (postharvest treatment, seed treatment, elm tree treatment, material preservative) and as a powder (material preservative in paints only).

The American and Canadian use patterns were compared and it was found that at the time of the RED document, thiabendazole was registered in the United States as:

- as postharvest treatment applied as a spray on potatoes (12 g a.i./1000 kg), and as a spray, flood or dip on fruits and vegetables: pome fruits, bananas, citrus fruits, peas, avocados, mango, papaya, plantain, carrots, beans, crimson clover, and rice (3.0 g a.i./L), as well as ornamental bulbs and corms (1g a.i./L);
- a seed treatment on potatoes seed pieces, sweet potato, soybean, and wheat prior to planting with a maximum application rate of 5 g a.i./100 kg;
- a material preservative on paints, carpets, adhesives and textiles with a maximum application rate of 0.3% a.i. in the final product;
- an elm and sycamore tree treatment with a maximum application rate of 6.5 g a.i./L;
- an irrigation application on mushrooms with a maximum application rate of 100 g a.i./100m^2.

The American formulations included a ready-to-use, dust, flowable concentrate, emulsifable concentrate, wettable powder, granules and water dispersible granules.

Based on this comparison of use patterns, the PMRA concluded that the USEPA RED for thiabendazole provides enough information for the re-evaluation of uses of thiabendazole in Canada. When necessary, additional risk assessments were conducted by the PMRA.

All thiabendazole uses supported by the registrants are included in the re-evaluation of thiabendazole except for the use on white button mushrooms. This use was added to the Canadian label in 2010 following a separate evaluation under the User Requested Minor Use Label Expansion (URMULE) Program. The PMRA determined that the use pattern expansion will have no effect on the outcome of this review. All thiabendazole products registered as of February 8, 2010 under the authority of the *Pest Control Products Act* are listed in Appendix I.

3.0 Impact on Human Health and the Environment

In their 2002 RED, the USEPA concluded that the end-use products formulated with thiabendazole met the safety standard under the American *Food Quality Protection Act* and that thiabendazole would not pose unreasonable risks or adverse effects to humans and the environment if used according to amended product labels.

3.1 Human Health

Toxicology studies in laboratory animals describe potential health effects resulting from various levels of exposure to a chemical and identify dose levels at which no effects are observed. Unless there is evidence to the contrary, it is assumed that effects observed in animals are relevant to humans and that humans are more sensitive to effects of a chemical than the most sensitive animal species.

In Canada, exposure to thiabendazole may occur through consumption of food and water, through residential exposure, while working as a mixer/loader/applicator, when entering treated sites or when handling treated commodities. When assessing health risks, the PMRA considers two key factors: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (for example, children and nursing mothers).

3.1.1 Occupational Exposure and Risk Assessment

Occupational risk is estimated by comparing potential exposures with the most relevant endpoint from toxicology studies being used to calculate a margin of exposure (MOE). This is compared to a target MOE incorporating safety factors protective of the most sensitive subpopulation. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be required. The USEPA's toxicological endpoints for assessing risk from occupational exposure are summarized in Appendix II.

3.1.1.1 Mixer/Loader/Applicator Exposure and Risk

The USEPA identified 13 possible occupational scenarios for mixers, loaders, applicators and other handlers. Among the scenarios assessed in the RED, the following exposure scenarios were considered relevant to the Canadian situation:

- Mixing/loading/applying liquid formulation for postharvest treatments assuming the maximum application rate of 0.3 g a.i./1000 kg and 653,000 kg treated per day;
- On-farm manual seed treatment at the maximum application rate of 5 g a.i./100 kg of wheat;
- Applying paints containing thiabendazole using a paintbrush assuming the maximum application rate of 1.32 g a.i./L and 7.6 L of paint applied daily;
- Applying paints containing thiabendazole using an airless sprayer assuming the maximum application rate of 1.32 g a.i./L and 19 L of paint applied daily;
- Commercial seed treatment;
- Tree injection; and
- Mixing/loader of a powder formulation (water soluble packages) for use as a material preservative.

Handler exposure analyzes were performed using the Pesticide Handlers Exposure Database (PHED) and assuming baseline personal protective equipment (PPE) consisting of single layer clothing and gloves. For the scenario not covered by PHED, i.e., on-farm seed treatment, unit exposure values from the exposure study (wheat seed treatment with lindane) were used by the USEPA.

The USEPA reported acceptable combined (dermal plus inhalation) MOEs above the target MOE of 100 for the following occupational exposure scenarios:

- Mixing/loading/applying liquid formulation for postharvest treatment;
- Applying paints containing thiabendazole to surface using a paintbrush;
- Applying paints containing thiabendazole to surface using an airless sprayer.

For the on-farm seed treatment scenario the estimated MOE was below the target MOE of 100, indicating a risk of concern. However, since the on-farm seed treatment use in the United States was practically nonexistent, instead of refining the exposure assessment, the USEPA recommended the removal of the on-farm seed treatment from end-use product labels.

For the thiabendazole use as a commercial seed treatment, tree injection, and material preservative in paints and adhesives, only qualitative risk assessments were performed by the USEPA. All assessed scenarios were expected to result in minimal exposure.

The USEPA did not assess a mixer/loader/applicator scenario for thiabendazole use as a material preservative in paper products and textiles.

The relevance of the USEPA conclusions to the Canadian situation is discussed below.

Mixing/loading liquid formulation for postharvest treatment

For the mixer/loader of liquid formulation for post-harvest treatment of pome fruits (apple and pear), the Canadian maximum application rate is slightly higher than the assessed American rate. The combined MOE of 910 for the USEPA's scenario provides sufficient protection to account for the difference in application rates between the United States and Canada.

For the mixing/loading of liquid formulation for post-harvest treatment of potatoes and chicory roots, the Canadian maximum application rate is significantly higher than the assessed American rate. As the combined MOE for the USEPA's scenario does not provide sufficient protection to account for the difference in application rates, the potential short- and intermediate-term exposure of workers involved in post-harvest treatment of potatoes and chicory roots was assessed by the PMRA using unit exposure values from the Canadian PHED tables. Assumptions included the maximum application rate of 40 g a.i./1000 kg for chicory roots and 44 g a.i./1000 kg for potatoes and, an amount of commodities treated per day of 150 000 kg for chicory roots and 800 000 kg for potatoes.

For the chicory root post-harvest treatment scenario, the estimated combined exposure at the baseline level of protection (single layer clothing and gloves) resulted in an MOE above the target MOE of 100, indicating no risk of concern. However, for the potato post-harvest treatment scenario, the estimated combined exposure at the highest level of protection (coveralls over single layer clothing, gloves) resulted in an MOE below the target MOE of 100, indicating a risk of concern.

Therefore, in order to minimize exposure of workers involved in post-harvest treatment activities the PMRA proposes the following mitigation measures:

- limit the amount of potatoes treated per day to 500 000 kg per worker,
- limit application methods to a mechanical sprayer;
- additional PPE consisting of coveralls over single layer clothing and chemical resistant gloves.

The proposed reduction to 500,000 kg per worker of the amount of potato tubers treated per day resulted in an MOE below the target MOE of 100 however, taking into consideration a highly conservative risk assessment, the fact that the application would be done mechanically and, the proposed PPE, the PMRA believes that the risk for workers involved in the post-harvest treatment of potatoes should be adequately mitigated. The proposed label amendments are listed in Appendix III.

Mixing/loading liquid formulation for on-farm seed treatment
The PMRA refined the risk assessment for the on-farm seed treatment with thiabendazole using exposure estimates from a surrogate exposure study submitted by the registrant. The study measured exposure of workers, wearing PPE consisting of coveralls, socks, boots, hat and gloves. The typical work day included seed treatment using auger equipment, planting treated seed and cleaning/maintenance activities.

The potential daily exposure of on-farm workers was estimated assuming the maximum application rate of 34.8 g a.i./100 kg seed, a planting rate of 200 kg seed per hectare, a high value of area planted per day of 100 ha, and an average worker body weight of 70 kg. The estimated combined exposure dose resulted in an MOE above the target MOE of 100, indicating no risk of concern.

Based on the PPE used in the exposure study, additional PPE consisting of coveralls, socks, boots, hat and gloves, similar protection equipment is recommended for workers involved in on-farm seed treatment with thiabendazole. In addition, a dust mask is recommended to minimize inhalation exposure from treated seed.

Since the exposure study is representative of an auger method only and higher daily exposure of workers using a hopper box or seed drill is expected, removal of hopper box and seed drill application methods from the current Canadian label is proposed, unless further data or a suitable scientific rationale are provided. The proposed label amendments are listed in Appendix III.

Commercial seed treatment

The PMRA conducted a risk assessment for the commercial seed treatment scenario using exposure estimates from a surrogate exposure study previously submitted by the registrant. The study measured daily exposure of various workers i.e., treaters, baggers/sewers/stackers, forklift drivers and cleaners, wearing PPE consisting of chemical resistant coveralls, long sleeved-shirt, long pants during a typical work day.

The potential daily exposures of workers were estimated assuming the maximum application rate of 34.8 g a.i./100 kg seed, an amount of seed treated per day of 55 000 kg, and an average worker body weight of 70 kg. The combined MOEs for all workers, i.e., treaters, cleaners, baggers/sewers/stackers and forklift operators were above the target MOE of 100, therefore, indicating no risk of concern.

Based on PPE used in the exposure study, additional PPE consisting of chemical resistant coveralls over single layer clothing, similar protection equipment is recommended for workers involved in seed treatment activities in commercial settings. In addition, a dust mask is recommended to minimize inhalation exposure from treated seed. The proposed label amendments are listed in Appendix III.

Material preservative use

Currently in Canada, both liquid and wettable powder formulations of thiabendazole are registered for use as a material preservative. In lieu of specific exposure data, the PMRA used daily exposure values for workers wearing single layer clothing and gloves from the Chemical Manufacturers Association (CMA) Antimicrobial Exposure Assessment Study. The study measured exposure of industrial workers during mixing/transfer of antimicrobials to industrial systems.

The daily exposure dose for workers applying liquid or wettable powder formulations were estimated based on the 90th percentile of dermal and inhalation exposure values from the CMA study.

For liquid formulation scenarios, the estimated exposure doses for liquid pour and for liquid pump resulted in combined MOEs above the target MOE of 100, indicating no risk of concern. However, for the wettable powder scenario, the estimated combined exposure dose resulted in an MOE below the target MOE of 100, indicating a risk of concern.

Packaging of a wettable powder formulation in water soluble pouches is considered by the PMRA as a closed delivery system that is associated with a minimal exposure. Therefore, in order to minimize exposure of workers in industrial settings, the PMRA recommends packaging of thiabendazole wettable powder formulation in water soluble pouches and additional PPE consisting of a long-sleeved shirt, long pants and chemical resistant gloves. The proposed label amendments are listed in Appendix III.

Application of thiabendazole-treated paint using a paintbrush or an airless sprayer
The Canadian maximum application rate for thiabendazole use in paint is slightly higher than the assessed American rate however, the MOEs reported by the USEPA for both paintbrush and airless sprayer scenarios provide sufficient protection to account for the difference in application rates between Canada and the US. Consequently, no mitigation measures are required.

Elm tree treatment
The USEPA conclusion was found to be relevant to the Canadian situation. Since the USEPA risk assessment assumed workers wearing single layer clothing and gloves, similar PPE is required by the PMRA. The proposed label amendments are listed in Appendix III.

3.1.1.2 Post-application Exposure and Risk

Based on the thiabendazole use pattern, workers could be exposed to residues while entering treated sites and while handling treated commodities (including fruits, vegetables, seed) or products (including textiles) to which thiabendazole was applied.

As per the Worker Protection Standard, a 12-hour Restricted-Entry Interval (REI) was required by the USEPA for workers re-entering treated sites. These conclusions are considered relevant to the Canadian situation and, a 12-hour REI is recommended by the PMRA for all agriculture uses. The proposed label amendments are listed in Appendix III.

For the scenarios consisting of sorting/packing/culling activities of treated commodities, the USEPA risk assessment resulted in an MOE of 1600, indicating no risk of concern. Consequently, no mitigation measures are required by the PMRA.

For the scenario involving the planting of commercially-treated seeds, the PMRA concluded that exposure for the worker loading and pouring commercially-treated seed should not be of concern provided that the worker is wearing PPE consisting of a long-sleeved shirt, long pants and chemical resistant gloves. The proposed label amendments are listed in Appendix III.

For the handling of thiabendazole-treated product, e.g., textiles, the PMRA concluded that exposure of workers to thiabendazole should be minimal since thiabendazole is applied during the manufacturing process and the active is expected to be bound to the material.

3.1.2 Non-Occupational Exposure and Risk Assessment

3.1.2.1 Residential Exposure

Residential exposure is estimated using the MOE approach described in Section 3.1.1. The toxicological endpoints selected by the USEPA for assessment of risk from residential exposure are summarized in Appendix III.

Based on the use pattern, the PMRA determined that individuals in residential settings can be exposed to thiabendazole when applying thiabendazole-treated paint and when coming in contact with thiabendazole-treated products, e.g. carpet. In addition, children can be exposed to thiabendazole as a result of an incidental ingestion of paint chips containing the active ingredient.

The daily exposure dose of an individual applying thiabendazole-treated paint was estimated by the PMRA using unit exposure values from the Canadian PHED Tables and assuming that homeowner will be wearing a short-sleeved shirt, short pants and no gloves. Additional assumptions included the maximum application rate of 0.3% a.i. and a volume of paint handled per day of 7.6 L for and 19 L for the paintbrush and airless sprayer applications, respectively. Both paintbrush and airless sprayer scenarios resulted in combined MOEs below the target MOE of 100, indicating a risk of concern. Consequently, in order to minimize homeowner exposure a mitigation measure, i.e., reduction of a maximum application rate of thiabendazole in paint to 0.2% is recommended by the PMRA. The proposed label amendments are listed in Appendix III.

For post-application exposure of individuals touching thiabendazole-treated products, the exposure of individuals who exercise/play on carpet, into which thiabendazole was incorporated, was considered by the USEPA as the worst-case scenario. The USEPA assessed exposure of a child and adult to thiabendazole using exposure estimates from a surrogate exposure study. The study measured exposure of individuals to pesticide applied to a carpet using an indoor fogger. Such a scenario was considered highly conservative because residues on a carpet following the surface application of a chemical are expected to be significantly higher and more readily dislodgeable than residues incorporated into material during the manufacturing process. The USEPA concluded that exposure of individuals in residential settings to thiabendazole applied during the manufacturing process was not of concern and, no mitigation measures were required. This conclusion was found to be relevant to the Canadian situation and, consequently, no mitigation measures are required.

The risk assessment for incidental oral exposure of children resulting from the ingestion of paint chips containing thiabendazole was conducted by the PMRA using the USEPA Standard Operating Procedures for Residential Exposure Assessment (USEPA 1997). The estimated potential exposure resulted in an MOE above the target MOE of 100, indicating no risk of concern. No mitigation measures are required.

Based on the fact that none of the end-use product was granted a "no objection status" by Health Canada, the PMRA recommends that the thiabendazole product labels should include specific prohibition against the use of thiabendazole treated material (including paper and adhesives) for food packaging. The proposed label amendments are listed in Appendix III.

3.1.2.2 Exposure from Food and Drinking Water

Acute dietary risk is calculated considering the highest ingestion of thiabendazole that would be likely on any one day, and using food consumption and food residue values. A statistical analysis allows all possible combinations of consumption and residue levels to be combined to estimate a distribution of the amount of thiabendazole residue that might be consumed in a day. A value

representing the high end (99.9th percentile) of this distribution is compared to the acute reference dose (ARfD), which is the dose at which an individual could be exposed on any given day and expect no adverse health effects. When the expected intake of residues is less than the ARfD, then acute dietary exposure is considered acceptable.

The acute reference dose of 0.1 mg/kg-bw/day was established by the USEPA based on the NOAEL of 10 mg/kg-bw/day from an oral developmental toxicity study in rats and the uncertainty factor of 100 (10x for interspecies extrapolation and 10x for intraspecies variation). The USEPA reported that acute dietary risk estimates for all population subgroups were below 100% of the aPAD with the highest estimated risk found for children 1-6 years of age (77% of the aPAD).

Chronic dietary risk is estimated by determining how much of a pesticide residue may be ingested with the daily diet and comparing this potential exposure to an acceptable daily intake, which is the dose at which an individual could be exposed over the course of a lifetime and expect no adverse health effects. The acceptable daily intake is referred to as the ADI in Canada, and, in the RED, it is expressed as the chronic population adjusted dose (cPAD). The ADI is based on a relevant endpoint from toxicology studies and on safety factors protective of the most sensitive subpopulation.

The Chronic Adjusted Dose of 0.1 mg/kg-bw/day was established by the USEPA based on the NOAEL of 10 mg/kg-bw/day from a 2-year feeding study in rats and the uncertainty factor of 100 (10× for interspecies extrapolation and 10× for intraspecies variation). The USEPA determined that chronic dietary risk estimates for all population subgroups were below 100% of the cPAD with the highest estimated risk found for children 1-6 years old (2% of the cPAD).

According to the USEPA's Cancer Assessment Review Committee (CARC), thiabendazole is classified as "likely to be carcinogenic to humans by the oral route". The USEPA determined that thiabendazole is not genotoxic nor mutagenic and, it is carcinogenic only in doses high enough to cause disturbance of the thyroid hormone balance. On this basis, the CARC recommended the margin of exposure approach for the quantification of human cancer risk. The USEPA believed that a target MOE of 100 would be adequately protective of human health for cancer effects by the oral (dietary) route. The cancer dietary risk assessment for thiabendazole resulted in an MOE of 13 000 for the general population and was below the USEPA's level of concern.

Due to the lack of monitoring data necessary to determine exposure to thiabendazole from drinking water, the USEPA estimated thiabendazole concentration (Estimated Drinking Water Concentration, EDWC) in groundwater and surface water using the SCI-GROW and GENEEC models, respectively. The calculated estimates for thiabendazole concentration in water, following the planting of 100 kg wheat seed treated with thiabendazole (0.22 kg a.i./100 kg) per hectare, were as follows: groundwater - 0.01 ppb, surface water - 2.4 ppb (acute) and 1.5 ppb (chronic).

Subsequently, the USEPA calculated acute and chronic Drinking Water Level of Concerns (DWLOCs) for all population subgroups based on EDWCs in groundwater (0.01 ppb) and surface water (acute of 2.4 ppb, chronic of 0.5 ppm[3]), acute and chronic food exposure values, default body weights and water consumption information. The resulting DWLOCs ranged from 230 to 3500 ppb.

The calculated EDWCs were below the DWLOC for all population subgroups, and thus, the USEPA concluded that acute and chronic exposures to thiabendazole from drinking water is not of concern. No mitigation measures were required by the USEPA.

The USEPA conclusions are relevant to the Canadian situation. On this basis, no mitigation measures are required by the PMRA.

3.1.2.3 Aggregate Risk Assessment

Aggregate risk combines the different routes of exposure to thiabendazole (i.e. from food, water and residential exposures). The USEPA assessed the acute, short-/intermediate-term and chronic aggregate exposures to thiabendazole.

The acute aggregate risk assessment considered a one-day oral exposure from food and water only and was found to be not of concern. The acute dietary exposure was not concern and, since the estimated peak concentration of thiabendazole in surface water of 2.4 ppb was below the EPA's DWLOCs (230 to 1500 for acute exposure) for all population subgroups, the acute aggregate risk was concluded to be not of concern.

Short- and intermediate-term aggregate risk assessments considered exposure from food, drinking water and residential exposure. The USEPA assessed short-term (1-7 days) and intermediate-term (1-6 months) aggregate exposure of:

- individuals (adults, children and infants) exposed to thiabendazole from treated carpet and food, and
- individuals (adults only) exposed to thiabendazole from paint and food.

The dietary and residential exposures were not of concern and, since the estimated average concentrations of thiabendazole in surface (0.5 ppb) and groundwater (0.01 ppb) were below the EPA's DWLOC (3,000), the USEPA concluded that short- and intermediate-term aggregate exposure of individuals to thiabendazole was not of concern.

The chronic aggregate risk estimates considered exposure to food and water only. The exposure from thiabendazole-treated paints was not included in the USEPA assessment because it was considered to be impermanent. Although the exposure to thiabendazole-treated carpet could be long-term, the USEPA determined that it would dissipate over time and; therefore, was not considered in the chronic aggregate risk assessment. Based on the highest estimate for dietary

[3] According to the USEPA's Health Effect Division policy for the chronic DWLOC calculation, the chronic EDWC in surface water of 1.5 ppb was divided by 3 resulting in a chronic EDWC of 0.5 ppb.

exposure (2% of cPAD for 1-6 years old) and the estimated average concentration of thiabendazole in surface water of 0.5 ppb (DWLOC of 3,000 ppb), the USEPA concluded that the aggregate chronic exposure was not of concern.

Since the chronic/cancer dietary risk was not of concern (MOE of 13,000), the USEPA concluded that the chronic/cancer aggregate risk is not expected to be of concern.

Overall, the Canadian aggregate exposure scenarios were adequately addressed by the American aggregate risk assessment and, the USEPA conclusion are relevant to the Canadian situation. No mitigation measures are required by the PMRA.

3.1.3 Cumulative Effects

The USEPA has not determined whether thiabendazole has a common mechanism of toxicity with other substances or whether it shares a toxic metabolite produced by other substances. Therefore, it was assumed that thiabendazole does not share a common mechanism of toxicity with other substances, and a cumulative risk assessment was not required.

3.2 Environment

3.2.1 Environmental Risk Assessment

- Thiabendazole is persistent in soil with an extrapolated half-life ranging from 883 to 1,444 days.
- Thiabendazole strongly binds to soil, therefore, leaching into the groundwater or runoff into surface water is not expected.
- Thiabendazole is stable to photolysis in soil, but is extremely susceptible to direct photolysis in water with a half-life of 29 hours. Three thiabendazole degradation products were identified: benzimidzole-2-carboxamide, benzimidazole and benzimidazole-2-carboxylic acid.
- Thiabendazole is stable to the hydrolysis with a half-life in water $\geq$203 days.
- Thiabendazole undergoes slow microbial degradation under anaerobic conditions, but is resistant to the metabolism under anaerobic conditions; benzimidazole is the major metabolite identified in an anaerobic soil metabolism study. No trace of benzimidazole was found in any soil layer in a field study.

Based on acute toxicity studies the USEPA determined that thiabendazole was highly toxic to freshwater fish, freshwater invertebrates, and estuarine/marine invertebrates.

Acute toxicity testing with estuarine/marine fish and, chronic toxicity testing with a freshwater fish and an aquatic invertebrate were not required for the seed treatment use of thiabendazole.

To assess the ecological risk of thiabendazole to both terrestrial and aquatic non-target plants and animals, the USEPA calculated risk quotients (RQs) based on appropriate toxicity endpoints and expected environmental concentrations (EECs) and compared the resulting RQs to corresponding levels of concern (LOCs).

The USEPA determined that the seed treatment use had the highest potential for environmental exposure and, therefore, was considered as a worst-case scenario. To estimate aquatic RQs the USEPA used estimates of thiabendazole concentration in groundwater and surface water generated using the SCI-GROW and GENEEC models, respectively (for more details see Section 3.1.2.2). The results of the aquatic risk assessment indicated that no acute or chronic LOCs were exceeded for freshwater fish or freshwater invertebrates.

Since thiabendazole use as a seed treatment would result in minimal contamination of surface water, an aquatic plant toxicity data was not required by the USEPA.
The risk assessment for terrestrial animals was not performed because thiabendazole was found to be practically non-toxic to birds and mammals on an acute oral basis. On this basis, the potential for thiabendazole to have adverse effects on terrestrial species was not expected.

Based on the qualitative risk assessment, the USEPA determined that exposure of terrestrial wildlife from direct injection of thiabendazole into trees is expected to be minimal.

No mitigation measures were required by the USEPA.

The potential exposure and risk to the environment from the registered Canadian uses of thiabendazole were adequately addressed in the USEPA risk assessment. The US environmental risk assessment encompasses the Canadian maximum application rate for seed treatment and, therefore, the USEPA conclusions are relevant to the Canadian situation.

Thiabendazole use as a material preservative was not included in the USEPA environmental risk assessment. However, the PMRA believes that environmental exposure to thiabendazole resulting from material preservative uses will be minimal due to rapid thiabendazole photolysis in water ($t_{1/2}$=29 hours). In addition, existing Canadian water monitoring data showed no detection of thiabendazole in Canadian waters.

Based on PMRA general practices, general environmental hazard label statements for aquatic species and effluent discharge are recommended to be added to all end-use products labels.

3.3 Pest Control Product Policy Considerations

3.3.1 Toxic Substances Management Policy Considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances (those that meet all four criteria outlined in the policy, i.e., CEPA-toxic or equivalent, predominantly anthropogenic, persistent (in one media) and bio-accumulative.

During the re-evaluation process, thiabendazole was assessed in accordance with the PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*, and evaluated against the Track 1 criteria for persistence and bioaccumulation. In order for thiabendazole or its transformation products to meet Track 1 criteria, the criteria for both bioaccumulation and persistence (in one media) must be met.

- **Persistence.** Thiabendazole was observed to have half-live values in soil ranging from 883 to 1444 days exceeding the TSMP Track 1 criterion (half life in soil ≥180 days in soil). Thiabendazole meets the criterion for persistence.

- **Bioaccumulation**. The *n*-octanol–water partition coefficient (log K_{ow}) of 2.12 is below the TSMP Track 1 criterion (log K_{ow} ≥5.0). Thiabendazole does not meet the criterion for bioaccumulation.

On this basis, the PMRA concluded that thiabendazole does not meet all Track 1 criteria, therefore, is not considered a candidate for Track 1 classification.

3.3.2 Contaminants and Formulants of Health or Environmental Concern

During the re-evaluation of thiabendazole, contaminants in the technical product are compared against the *List of Pest control Product Formulants and Contaminants of Health or Environmental Concern* maintained in the *Canada Gazette*.[4] The list is used as described in the PMRA Notice of Intent NOI2005-01 and is based on existing policies and regulations including: DIR99-03; and DIR2006-02, and taking into consideration the Ozone-depleting Substance Regulations, 1998, of the *Canadian Environmental Protection Act* (substances designated under the Montreal Protocol). The PMRA has reached the following conclusion:

Technical grade thiabendazole does not contain any contaminants of health or environmental concern identified in the *Canada Gazette.*

The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02.

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[4] *Canada Gazette*, Part II, Volume 139, Number 24, pages 2641–2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern* and in the order amending this list in the *Canada Gazette*, Part II, Volume 142, Number 13, pages 1611-1613. *Part 1 Formulants of Health or Environmental Concern, Part 2 Formulants of Health or Environmental Concern that are Allergens Known to Cause Anaphylactic-Type Reactions and Part 3 Contaminants of Health or Environmental Concern.*

4.0 Incident Reports

Starting 26 April 2007, registrants are required by law to report incidents, including adverse effects to health and the environment, to the PMRA within a set time frame.

There were no incident reports submitted for thiabendazole as of February 8, 2010.

5.0 OECD Status of Thiabendazole

Canada is part of the Organisation for Economic Co-operation and Development (OECD), which groups 30 member countries and provides governments with a setting in which to discuss, develop and perfect economic and social policies. They compare experiences, share information and analyzes, seek answers to common problems, and work to co-ordinate domestic and international policies to allow for consistency in practices across nations.

Based on the current available information, the use of thiabendazole as a pesticide is permitted in the European Union (EU).

As described earlier in this document, the United States, also an OECD member, assessed the registration of all uses of thiabendazole in 2002 and concluded that using thiabendazole as a pesticide does not result in unreasonable adverse effects to human health or the environment provided the risk-reduction measures recommended in the RED document were implemented.

The Canadian re-evaluation of thiabendazole is largely based on the 2002 USEPA assessments and includes additional assessments if applicable. As described in Section 3.1 and 3.2 above, the PMRA has found the USEPA human health and environmental risk conclusions to be relevant to the use of thiabendazole in Canada and requires measures to further protect workers, bystanders and the environment.

6.0 Proposed Re-evaluation Decision

The PMRA has determined that thiabendazole is acceptable for continued registration with the implementation of the proposed risk-reduction measures. These measures are required to further protect human health and the environment:

- Additional PPE for workers involved in the post-harvest treatment of food commodities and, for on-farm and commercial seed treatment activities, and tree treatment.
- A 12-hour restricted-entry interval (REI) for all agriculture uses.
- A limit of potato tubers treated per day to 500,000 kg per worker.
- Restrict postharvest application methods to a mechanical sprayer application.
- Restrict seed treatment methods to commercial and on-farm treaters using auger treatments only.
- Packaging of powder end-use formulation in water soluble pouches.
- Rate reduction for thiabendazole application in paint to 0.2% a.i.
- A limitation of thiabendazole-treated materials to a non-food use only.

- General environmental hazard label statements for aquatic species and effluent discharge.

The labels of Canadian end-use products must be amended to include the label statements listed in Appendix III. A submission to implement label revisions will be required within 90 days of finalization of the re-evaluation decision.

It should be noted that for end-use products containing more than one active ingredient under re-evaluation, registration status might change as a result of the re-evaluation of the remaining affected active ingredients.

7.0 Supporting Documentation

PMRA documents, such as Regulatory Directive DIR2001-03, and DACO tables can be found on our website at www.healthcanada.gc.ca/pmra. PMRA documents are also available through the Pest Management Information Service. Phone: 1-800-267-6315 within Canada or 1-613-736-3799 outside Canada (long distance charges apply); fax: 613-736-3798; e-mail: pmra.infoserv@hc-sc.gc.ca.

The federal TSMP is available through Environment Canada's website at www.ec.gc.ca/toxics.

The USEPA RED document for thiabendazole is available on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

List of Abbreviations

µg	microgram
ADI	acceptable daily intake
a.i.	active ingredient
aPAD	acute population adjusted dose
ARfD	acute reference dose
ARI	aggregate risk index
bw	body weight
CAS	Chemical Abstracts Service
cPAD	chronic population adjusted dose
cRfD	chronic reference dose
DACO	data code
DWLOC	drinking water level of comparison
EDWC	estimated drinking water concentration
EEC	expected environmental concentration [also estimated environmental concentration]
FQPA	*Food Quality Protection Act*
g	gram(s)
ha	hectare
kg	kilogram(s)
K_{oc}	organic carbon partition coefficient
K_{ow}	*n*-octanol–water partition coefficient
L	litre(s)
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LOAEL	lowest observed adverse effect level
LOC	level of concern
LOD	limit of detection
mg	milligram(s)
mm Hg	millimetre mercury
MOE	margin of exposure
MRL	maximum residue limit
NOAEL	no observed adverse effect level
OECD	Organisation for Economic Co-operation and Development
PCPA	*Pest Control Products Act*
PHED	Pesticide Handlers Exposure Database
PIC	Prior Informed Concent
PMRA	Pest Management Regulatory Agency
ppb	parts per billion
PPE	personal protective equipment
PRVD	Proposed Re-evaluation Decision
RED	Reregistration Eligibility Decision
REI	restricted-entry interval
RfD	reference dose
RVD	Re-evaluation Decision
RQ	risk quotient

SCI-GROW	Screening Concentration in Groundwater
TC	transfer coefficient
TGAI	technical grade active ingredient
TSMP	Toxic Substances Management Policy
USEPA	United States Environmental Protection Agency

Appendix I Registered Products Containing Thiabendazole as of February 8, 2010

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
19065	technical	Syngenta Crop Protection Canada Inc.	Thiabendazole Technical		99.2% w/w
13450	commercial	LANXESS Corp.	METASOL TK-100 SOLUTION	solution	20% w/w
13975	commercial	Syngenta Crop Protection Canada Inc.	MERTECT SC FUNGICIDE	suspension	500 g/L
13995	commercial	LANXESS Corp.	METASOL® TK-100 POWDER	soluble powder	99.2% w/w
16694	commercial	Syngenta Crop Protection Canada Inc.	ARBOTEC 20-S	suspension	20% w/w
23430	commercial	Chemtura Canada Co./CIE,	CROWN Systematic and Contact Seed Protectant	suspension	58 g/L
25792	commercial	LANXESS Corp.	METASOL® TK-50AD	solution	50% w/w
25793	commercial	LANXESS Corp	METASOL® TK-25 AD	solution	24.8% w/w
29177	commercial	LANXESS Corp	METASOL® TK-100	soluble powder	99.2%
29430	commercial	Thomson Research Associates	Ultra-Fresh MS-25N	powder	99.2%
29431	commercial	Thomson Research Associates	Ultra-Fresh PF-79	solution	24.8%

Appendix II Toxicological Endpoints Selected by the Environmental Protection Agency for Thiabendazole Health Risk Assessments

Exposure Scenario	NOAEL	Endpoint	Target MOE and Uncertainty Factors (UF)
Acute dietary (females 13+ only)	NOAEL=10 mg/kg-bw/day	oral developmental toxicity study in the rat, LOAEL= 40 mg/kg-bw/day based on decrease fetal body weight	UF = 100 FQPA = 1X
	aPAD=0.1 mg/kg-bw bw/day		
Acute dietary (general population)	NOAEL=10 mg/kg-bw/day	oral developmental toxicity study in the rat, LOAEL = 40 mg/kg-bw/day based on decreased maternal body weight during gestation	UF = 100 FQPA = 1X
	aPAD=0.1 mg/kg-bw bw/day		
Chronic dietary	NOAEL=10 mg/kg-bw/day	2-year feeding/chronic carcinogenicity study in the rat, LOAEL = 30 mg/kg-bw/day based on decreased body-weight gains and liver hypertrophy	UF = 100 FQPA = 1X
	cPAD=0.1 mg/kg-bw/day cancer POD = 10 mg/kg-bw/day established based on the findings of thyroid tumors at 30 mg/kg bw/day as well as decrease in T3 and increase in TSH at 90 mg/kg bw/day (2 year chronic/carcinogenicity study in the rat)		
Short-term dermal and inhalation	NOAEL=10 mg/kg-bw/day	oral developmental toxicity study in the rat, LOAEL = 40 mg/kg-bw/day based on decreased fetal body weight	residential/occupational target MOE = 100 UF = 100X
Intermediate-term dermal and inhalation	NOAEL=10 mg/kg-bw/day	14-week oral feeding study in the rat, LOAEL = 40 mg/kg-bw/day based on reduced body-weight gain, histological changes in bone marrow, liver and thyroid	residential/occupational MOE = 100 UF = 100X
Dermal Absorption factor = 60%		**Inhalation absorption factor = 100%**	

MOE- Margin of Exposure; POD - point of departure; Uncertainty factor (UF) of 100 (10× for interspecies extrapolation and 10x for intraspecies variation); FQPA - Food Quality Protection Act safety factor; aPAD - acute population adjusted dose; cPAD - chronic population adjusted dose

Appendix III Proposed Label Amendments for Products Containing Thiabendazole

The labels of end-use products in Canada must be amended to include the following statements to further protect human health and the environment.

I) For agriculture uses of thiabendazole the following statement must be included in the **PRECAUTIONS** section.

> Do not enter or allow the entry into treated areas until 12 hours after application.

II) For agriculture uses of thiabendazole the following statement must be included in the **DIRECTIONS FOR USE** section.

> Workers must wear coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves during mixing, loading, treating, clean-up, and repair.
>
> For post-harvest treatment of commodities, apply using mechanical sprayer only.
>
> A limit of 500,000 kg potato tubers may be treated per day per worker

III) For seed treatment uses of thiabendazole the following statements must be included in the **PRECAUTIONS** section:

> On-Farm seed treatment
> Workers must wear coveralls over a long-sleeved shirt and long pants, hat, chemical-resistant gloves, and a dust mask during mixing, loading, treating, clean-up, and maintenance of seed treatment equipment.
>
> Commercial seed treatment
> Workers must wear coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves during mixing, loading, treating, clean-up, maintenance of seed treatment equipment, and bagging, sewing or stacking of bagged treated seed. Wear a suitable dust mask when bagging or sewing bags of treated seed or when transferring seed to a storage bin.
>
> All bags containing treated seed for sale or use in Canada must be labelled or tagged as follows:
>
> "This seed has been treated with Seed Protectant Fungicide containing thiabendazole. Wear a long-sleeved shirt, long pants, and chemical resistant gloves when handling treated seeds. Do not use for food and feed. Store away from food and feed.

IV) For seed treatment uses of thiabendazole the following statements must be included in the **DIRECTIONS FOR USE** section:

> For use by commercial treaters and on-farm treaters using auger treating only.

V) For seed treatment uses of thiabendazole the following application equipment must be removed from the **GENERAL INFORMATION** section:

> hopper box and seed drill

VI) For tree treatment uses of thiabendazole the following statement must be included in the **PRECAUTIONS** section:

> Workers must wear a long-sleeved shirt and long pants, and chemical-resistant gloves when handling the product.

VII) For material preservative uses of thiabendazole the following statement must be included in the **PRECAUTIONS** section:

> Workers must wear a long-sleeved shirt, long pants and chemical-resistance gloves during mixing, loading, clean-up and repair activities.

VIII) For paint uses of thiabendazole the **DIRECTIONS FOR USE** section must be amended to reflect rate reduction from 0.3% a.i. to 0.2% a.i.

IX) Powder formulation of thiabendazole must be packaged in water soluble pouches. For the replacement products packaged in water soluble bags, the following aspects must be considered when revising the label:

> Pouch size must accommodate application rate.
> Label must include a component for the water soluble bag.

X) For powder formulations packaged in water soluble pouches the following statement must be included in the **PRECAUTIONS** section:

> HANDLING PRECAUTIONS: Do not handle the inner bag with wet gloves as the bag will begin to dissolve on contact with even a small amount of water. Do not open the inner bags or attempt to remove the product from them. The water soluble packet is not designed to be remeasured or subdivided. The inner bag should not be opened and partial bag not used. The entire contents of the inner (water soluble) bag must be used.

XI) For powder formulations packed in water soluble pouches the following statement must be included in the **STORAGE** section:

> Do not remove pouch from overwrap container except for immediate use. Do not allow to become wet in storage. Keep container closed when not in use.

XII) For material preservative uses (adhesives and paper products) of thiabendazole the following label statement must be included on the **primary panel**:

> For use as a material preservative to control fungi in non-food contact materials and products.

XIII) For all uses of thiabendazole the following statements must be included in the **ENVIRONMENTAL HAZARDS** section:

> Toxic to aquatic organisms.
>
> DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.
>
> DO NOT discharge effluent containing this product into sewer systems, lakes, streams, ponds, estuaries, oceans and other waters.

The label amendments presented above do not include all label requirements for individual end-use products, such as first aid statements, disposal statements, precautionary statements and supplementary protective equipment. Additional information on labels of currently registered products should not be removed unless it contradicts the above label statements.

A submission to request label revisions will be required within 90 days of finalization of the re-evaluation decision.

References

Studies considered in the Chemistry Assessment

A. LIST OF STUDIES/INFORMATION SUBMITTED BY REGISTRANT

PMRA Document Number	Reference
1518551	Manufacturing summary DACO 2.11.1, 2.11.2, 2.11.3
1518552	Detailed Production Process Description DACO 2.11.3
1518562	Establishing Certified Limits DACO 2.12.1
1518569	Methodology/Validation DACO 2.13.1
1518583	Confirmation of Identity DACO 2.13.2
1518584	Batch data DACO 2.13.3
1518585	Impurities of toxicological Concern DACO 2.13.4

B. ADDITIONAL INFORMATION CONSIDERED

British Crop Protection Council, the e-Pesticide Manual (Twelfth Edition), Version 2.2 2002-2003, entry 750

Studies considered in the Health Risk Assessment

A. LIST OF STUDIES/INFORMATION SUBMITTED BY REGISTRANT

PMRA Document Number	Reference
1191375	On-farm operator exposure study with DIVIDEND 36FS seed treatment on wheat. Unpublished.
1262876	Magnitude of residue of thiabendazole in Endive leaves grown from stored roots treated postharvest with Mertec SC. Study No. 01TR01. Recherche Trifolium Inc. Unpublished.
1077394	Comparative dust-off measurements of corn treated with DYNASTY 100 FS vs. APRON FL on soybeans, DIVIDEND 36FS on wheat and HELIX Xtra on canola. Syngenta. Unpublished.
1349637	Helix seed treatment worker exposure study. Project No. CER 03220/99, Novartis Crop Protection Canada Inc. Unpublished.

B. ADDITIONAL INFORMATION CONSIDERED

PMRA Document Number	Reference
1311124	Byrtus, G. et al., 2002, Alberta Environment; The Water Research User Group, Determination of new pesticides in Alberta's surface water (1999-2000), Published, DACO: 8.6
1640595 & 1560632	Boldon, M. and Harty, C. 2003, Environment; Pesticides Management Unit, Pesticide Sampling Program for selected municipal drinking water supplies in New Brunswick, Published; DACO: 8.6